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No. XXIX.

An Improvement in the common Ship-Pump. By Robert Paterson.—Read, July, 1795—but afterwards mislaid.

NOTWITHSTANDING the numerous improvements that have, from time to time, been proposed in the construction of *ship-pumps*, yet, after all, the common *lifting pump* still remains in general use.

The paper, now submitted to the consideration of the society, is an attempt towards an improvement in *this* pump, by means of a very simple appendage, that may be readily applied at any time, when wanted, and by which a very considerable proportion of the manual labour, usually employed, will be saved.

The following is a description of this appendage, with the manner of its application and use.

I. Let a plug of white pine, cedar, or any other suitable wood, or of cork, be made, very nearly cylindrical, so as exactly to fit the bore of the pump above the nozzle.

II. Through the axis of this plug, a hole is to be bored, of the size of the pump-rod; and then the plug is to be split or cut through the axis or center of the hole.

III. Place this plug round the pump-rod, and let it be firmly inserted into the bore of the pump, above the nozzle; and

there secured by a pin or bolt driven through the pump, just above the plug, so as to prevent it from being raised by the force of the water acting against it. The part of the pump-rod that works in the plug may be made as round and smooth as possible, in order to prevent friction, and the passage of water through the hole. With the same view, the hole may be lined or packed with oakum, and a stratum of oil or slush placed over the plug.—It will be advisable to have the nozzle inserted as *low down* in the pump-tree as practicable, and thus, the vertical hole through the plug will be the less affected by the angular motion of the pump-rod.

IV. Round the nozzle of the pump, let there be fastened one end of a pretty wide open hose, of leather or painted canvas; the other end passing over or through the side of the vessel, and hanging down into the water. The pump, with this simple appendage, may be considered as a *siphon*, having the shorter leg outside, and the longer leg inside of the vessel; and the height to which the water will *in effect* have to be raised, by the action of pumping, will be no more than the *difference* between the height of the water in the hold and that outside of the vessel; and thus, frequently, more than *half* the usual labour of pumping will be saved.

REMARKS.

I. The height to which the water will, *in effect*, have to be raised by pumping, is that stated above, on the supposition of the vessel being at rest, or in still water: But if under way, and sailing with any considerable velocity through the water, as is generally the case when the pump is most employed, then the labour of pumping will be still further diminished. For, it is easy to demonstrate, from the principles of hydraulics, that the velocity of the open end of the hose through the water will have the effect of raising the water from the hold to a height equal to that from which a heavy body descending

would acquire that velocity (neglecting the effect of friction.) Thus, a velocity of little more than 4 $\frac{1}{2}$ knots per hour, would raise the water *one* foot; and a velocity of somewhat less than 9 $\frac{1}{2}$ knots, would raise the water *four* feet, &c. &c. And this effect will be still further increased by the *traction* of the external water on that issuing from the hose; which, in ordinary cases, will be far from inconsiderable.

II. The best way of applying the labour of men, or other animals, in the working of pumps or other machines is, when practicable, that in which both the *weight* of the animal, and the *strength* of its muscles are employed; and in which short intervals of exertion and rest, or of greater and less exertion, constantly succeed each other. The action of rowing a boat will serve as a very good example of this application of labour.

III. It follows from the above principle, that the manner of applying the labour of man in working a pump, in the common way, is perhaps the most injudicious that can well be conceived. His body serves only as a fulcrum for his arms to work on, its weight contributing little or nothing to the effect produced; this depending almost entirely on the exertion of the strength of his arms, and that in a direction which is, in general, the most fatiguing, and least effective possible; not to mention the constant reiterated *checks* which must be given to the action of the pump-handle, in its alternate up-and-down motion.

IV. The manner of working the pump which I would propose, as free from all the above inconveniences and imperfections, is the following.

1. Let the pump-brake, or handle, be in the form and position of a pretty heavy pendulum, and of such a length as that its natural oscillations may be nearly the same with those given it by the action of pumping.

2. Into this pendent pump-brake, let there be firmly fixed a long cylindrical pin, to serve as the immediate handle, and at right angles to the plane of the pendulum's motion.

3. Let the men working the pump be seated on a bench of a suitable height, with their feet pressing against a cleat or footstool, fastened to the deck; and in this position they will produce all the advantages which can possibly be derived from the exertion of animal force.

4. By placing the pendulum in such a position that its oscillations may correspond with the pitching or rocking of the vessel, the pumping, in ordinary cases, may, by this means, be frequently effected without manual labour.

5. By suffering a quantity of air to pass into the pump along with the water, the labour of pumping will be considerably alleviated, from the compressibility and diminished weight of the column of the mixture of air and water in the pump-barrel; and yet the total effect, in proportion to the quantity of force applied, will remain the same.